

**Problem Title: Improvement of Deck Concrete Mix Design
and Curing Practice**

UTRAC No. 05.08.-1

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1. Briefly describe the problem to be addressed:

Bridge deck replacement is costly. UDOT has had a mixed experience in the performance of these bridge decks. According to Linford and Reaveley (2004) in 70 out of the 71 bridges that were investigated along I-15 had some type of cracking very within a few years after completion. However, some bridges decks built prior to the I-15 project have performed well with minimal problems. This research statement proposes to investigate deck cracking as a function of the mix design. It is believed by some that a reduction in the shrinkage of the concrete deck mix by as little as 20% would reduce the concrete bridge deck cracking significantly. However, in order to improve upon the existing practice, an investigation into the performance of the current concrete deck mix design needs obtained.

2. List the research objective(s) to be accomplished:

- Obtain shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength of deck concrete from four representative bridges.
- Monitor the curing practices of four representative bridges.
- Develop an improved concrete deck mix design and curing specifications.

3. List the major tasks required to accomplish the research objective(s):

Phase 1

1. Meet with DOT representatives and pick representative bridges. (15 hours)
2. Perform a literature search on concrete deck mix designs from other states. (120 hours)
3. Obtain four concrete deck mix designs and test for shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength. (1400 hours)
4. Observe the deck curing practices of four representative bridges. (80 hours)
5. Have interim meeting (perhaps after two or three bridges) to obtain DOT's input. (20 hours)
6. Interim report. This will include the concrete test results (baseline for future improvements), summary of curing practices and recommendations for possible future mix designs. (120 hours)

Phase 2

1. Develop mix designs with the goal of decreasing shrinkage while maintaining or increasing the freeze-thaw durability, tensile strength and chloride penetration (1300 hours)
2. Implement new mix design in the bridge of a newly constructed bridge (200 hours)
3. Monitor the behavior of the new concrete deck mix design (80 hours)

Phase 3

- 1) Write new bridge deck mix design specifications and meet with UDOT if necessary (60 hours).
- 2) Write new bridge deck curing specifications and meet with UDOT if necessary (60 hours)

4) Outline the proposed schedule (when do you need this done, and how we will get there):

Depending on the availability of the four concrete deck samples, Phase 1 of this project is intended to last one year. It is preferable that all the deck mixes be obtained over the summer as the material tests for each bridge will last up to six to eight months. The literature review as well as the interim meeting with UDOT can be done in series with the other research. For Phase 2, the development of the new concrete deck mix designs can also be done in 1 year. However in Phase 2 we will monitor the new bridge deck and the length of this will depend on how long UDOT wishes to observe the bridge deck. It is anticipated that the writing for Phase 3 can be done in 3 months time.

5. Indicate type of research and / or development project this is:

Research Project.

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University in conjunction with UDOT Staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Improvements in UDOT's concrete deck curing specification and/or UDOT's concrete deck mix design specification.
- Concrete deck shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength of the existing and proposed mix.
- Report documenting all research findings.

8. Describe how will this project be implemented at UDOT.

The final goal of this project is to improve the concrete deck mix and curing specifications for UDOT. This will involve a change in the specifications and possibly the curing practices. It is important that goal be obtained by understanding where we are at and then making an improvement. This problem statement addresses both the current state of practice of UDOT and improvements.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Deck replacement is costly. This is made worse when a deck is cracked and major maintenance is required after only one or two years in service. Reducing the deck cracking and deterioration will save UDOT's scarce money, allow this money to be used on other necessary projects and benefit all the users of the state.

10. Describe the expected risks, obstacles, and strategies to overcome these:

Deck cracking is a national problem. However, if the solution were simple it would have been obtained long ago. The problem is that it needs to be investigated on a regional level due to differences in materials, practices and environmental conditions. The strategy to improve this problem is to obtain the state of current practice, gather solutions from other DOTs, find a solution that will fit UDOT needs.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

- Todd Jensen, Boyd Wheeler

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

Phase 1: \$35,000
Phase 2: \$30,000
Phase 3: \$5,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Todd Jensen, Boyd Wheeler, David Eixenberger, John Butterfield